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REMARKS

ON A

WATER SUPPLY FOR THE CITY OF COLUMBUS.

BY JOSEPH SULLIVANT.

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THE CITY COUNCIL.

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WATER SUPPLY FOR THE CITY OF COLUMBUS.

To the City Council of Columbus:

Gentlemen—For many years past I have in conversation urged the necessity of providing a supply of water for this city, not only in sufficient quantity for domestic consumption, but even for manufacturing purposes, and especially ~~as~~ to afford~~ing~~ increased protection from damage by fire.

I address myself to your honorable body as the authority having charge of the finances, and the power to originate and carry into effect such measures as the health, safety, or convenience and wants of the city may require. The following observations upon water works are submitted not with the expectation of inducing any immediate or decisive action in the matter, but with the hope of directing public attention to an important subject.

In the earliest ages, as man emerged from his selfish and solitary hunter's state, and assumed a nomadic life, we find him, with his family, his flocks and herds, roaming in search of green pastures and living waters: abiding longest where these were in greatest abundance, and shifting his temporary habitation as the declining pasturage or increasing drouth demanded. He had not yet learned to subdue the forces of nature to his use, and

was mainly dependent upon accidental combinations for the means of his subsistence. So we may say without exaggeration, that pure water, an element equally essential to vegetable and animal life, was an efficient agent in directing the migrations of mankind, fixing the habitations of men, and determining the localities of particular nations. For we may suppose that these patriarchal families grew into tribes and communities, and these into nations.

As man advanced in knowledge and civilization, he became more independent of the accidents of nature. Boring into the bowels of the earth, he tapped the reservoirs of hidden waters; or, diverting rivers from their natural course, made them subservient to his wants; and, bringing the crystal streams of distant springs over mountain and valley, along his splendid aqueducts, was enabled to locate his habitations and his cities wherever interest or caprice and fancy dictated.

Many enlightened cities, both of ancient and modern times, recognizing the intimate connection existing between health and comfort and an abundant supply of pure water, have deemed no expense too great, no trouble too much, to accomplish so desirable an end. The convenience, comfort and necessity of such a supply for communities, seems so plain, and will be so readily admitted, that no extended argument is necessary to enforce it, and we take it for granted, that neglect in such an obvious matter arises either from pecuniary inability to accomplish it, or from natural obstacles which neither skill nor ingenuity can overcome.

Three methods have usually been adopted for supplying cities with water:

First, the most ancient, and generally the most expensive, that by the aqueduct, where distant springs or streams have been brought in artificial channels or trunks, prepared for the purpose, and preserving their level in some cases by tunneling through the hills, and in others by carrying them across valleys on the top of enormous arches, and discharged at last into reservoirs, whence the water is made accessible to the inhabitants.

Secondly, where water from a stream, lake or pond adjacent to a city, is raised by water, wind or steam power, to a higher level, either natural or artificial, and emptied into a reservoir distributing a supply through pipes ramifying in every direction where the convenience of the inhabitants demands.

The third plan is that of the Artesian well, a name derived from the Province of Artois, (the ancient Artesium,) in France, where this method was first introduced, and where water is procured in such abundance by this means, that it is applied to turn the wheels of their corn mills. The Artesian well is nothing more nor less than an artificial spring, unceasingly pouring out its healthful and sparkling supply. This supply is obtained by perforating the earth frequently to a great depth, until, penetrating some deep-seated subterranean stream, which has its source in an elevated, and sometimes distant region, the water rises under hydrostatic pressure, and overflows at the surface of the earth.

In discussing the most appropriate plan for supplying the city of Columbus with water, I shall make no further allusion to the aqueduct, as for certain reasons it is entirely inapplicable to our case. Where a city depends entirely for its water supply upon artificial wells, an

Artesian well would no doubt be a valuable addition; but I do not consider an Artesian well, or a number of them, as at all fulfilling the demand, even if it were likely that they could be had in this locality. As there is a prevailing opinion that water *could* be cheaply introduced into the city by these means, I will, in order to show the uncertainty of success, briefly explain the general theory of springs and wells.

We are indebted to the simple process of evaporation for a constant supply of fresh water, which is constantly arising from the surface of the earth and the Ocean, in the form of vapor, and again descending in dew and rain.

In this region the annual fall of rain may be stated at about 36 inches in depth over the whole surface. Of this water a portion *only* is carried off by the streams and rivers; a part reäscends into the atmosphere, which is never without a portion of water in the state of vapor; some enters into combination in the structure of vegetable and animal organisms; and still another very considerable portion descends among the strata of the earth, and gradually accumulates into subterranean streams and sheets of water, which, when the strata are favorable, discharge at the surface in the form of perpetual springs. The essential conditions are, first, that the strata should be composed of alternating beds of clays, sands, gravel, and rocks, some of which are permeable to water, and some of which are not. Second, the dislocation or displacement of these strata, either by elevation or subsidence, or the intrusion of other rocks, producing fractures, dykes and faults.

The water in all these strata is derived from the rain that falls on the permeable portion of their surface and

which sinks down through the porous materials and fills their lowest region with a sheet of water. When wells are dug or bored into these water-bearing strata the supply will be found abundant in proportion to the extent of surface and depth of permeable materials.

The simplest form of a water-bearing stratum is found within the city limits, where superficial beds of clay, sand and gravel have accumulated within a basin, and rest upon an impervious sub-stratum of blue clay, which inclines from the high table lands east and northeast of the city, and crops out upon the river at about the level of the wharf. Hence it is easy to understand why, even in dry weather, it is moist or wet along the bank at the top of the wharf, and that at an early period gushing springs were found in the same situation. These have now in a great measure disappeared, owing, in part, to the great number of wells sunk in the water-bearing stratum, and intercepting a portion of water; but I apprehend a more efficient cause is to be found in an increase of evaporation resulting from the clearing of the land between the city and Alum creek, and to the more perfect and rapid surface drainage, which quickly carries off a greater portion of the rain water than formerly. As these causes are far more likely to increase than diminish in effect, and as I believe the water supply of our wells is derived from a very limited area of country, it is not only *possible, but probable,* that the time will come when the supply from this source will be entirely inadequate to the wants of the city.

The rise of water in the ordinary well and in an artesian well depends upon the same principle as the overflow from springs, and can be better understood from

the following diagrams from a geological work. No. 1 is intended to illustrate two causes of the production of springs by *descent* of water from porous strata at higher levels; the first producing discharges in valleys along the line of junction of porous with impermeable strata; the other by the interruption offered to descent of water by faults that intersect the strata.

The hills A. C. are supposed to be formed of a permeable stratum, a a′ a″, resting on an impervious bed of clay, b. b. b. Between these two hills is a valley, B; towards the head of this valley the juncture of the permeable stratum a a′, with the clay bed b. b., produces a spring at the point S; for here the intersection of these strata by the valley affords a perennial issue to the rain water which falls upon the adjacent upland plain, and percolating downwards to the bottom of the porous stratum, a a, accumulates therein until it is discharged by numerous springs, in positions similar to S, near the head and along the sides of the valleys which intersect the junction of the stratum a a″ with the stratum b. b. The hill C. represents the case of a spring produced by a fault, H; the rain that falls upon this hill, between H and D descends through the porous stratum a″ to the bed of clay b.. The inclination of this bed directs its course towards the fault H, where its progress is intercepted by the dislocated edge of the clay bed b, and a spring is formed at the point f. Springs originating in the two causes shown in the diagram are of the most common occurrence in this region.

No. 2 illustrates the cause of the rise of water in natural or artificial springs within *basin-shaped strata* that are intercepted by the sides of valleys, as is the case in

this region also. Suppose a basin composed of permeable strata, E. F. G., alternating with impermeable strata H I K L, to have the margin of all these strata continuous in all directions at one uniformly horizontal level, A B ; the water which falls in rain upon the extremities of the strata E. F. G. would accumulate within them and fill all their interstices with water up to the line A B, which represents the general level of the margin of the basin. A disposition of strata so regular, however, *never exists in nature*, the extremities or *outcrop* of each stratum are usually at different levels, as a. c., e. g. In such cases the dotted line a. b. represents the water level within the stratum G ; *below* this line water would be permanently present in G, but it *could never rise above it*, being relieved by springs that would overflow at a. The line c d represents the level above which the water could never rise in the stratum F; and the line e. f. the highest level within E, the *discharge* of all rain waters that percolated the strata E. F. G. being effected by overflowing at e. c. a. If common wells were perforated from the surface i. k. l. into the strata E. F. G. the water would rise within them only to the horizontal lines a. b. c. d., e f. The upper porous stratum C. also would be permanently loaded with water below the horizontal line g. h. and permanently *dry* above it.

The theoretical section No. 3 represents a portion of a basin intersected by the fault H L, and filled with materials impermeable to water.

Supposing the lower extremities of the inclined and permeable strata N O P Q to be intersected by the dike or fault H L, the rain water which enters the uncovered portions of these strata between the imperme-

able clay beds A. B. C. D. E. would accumulate in the strata N. O. P. Q. up to the horizontal lines A A.. B B.. C C.. D D.. E E.. If an Artesian well was bored into each of the strata A. B. C. D. E.. through the clay beds A B C D E, the water would rise within a pipe, ascending from the perforations to the level A.. B.. C.. D.. E..

These theoretical results can never occur to the extent here represented, in consequence of the intersection of the strata by valleys, the irregular interposition of faults and the varying composition of the matter composing dikes. They serve, however, to illustrate the theory of Artesian wells and enable us *to try our case* by the principles here laid down; and a simple inspection of the accompanying geological section, with the explanations, will convince any one that there is *much* uncertainty of obtaining water in Columbus from an Artesian well.

EXPLANATION OF THE GEOLOGICAL SECTION.

The geological section includes a distance of 10¾ miles, commencing 7¾ miles west of the city, at the summit between the Scioto and Big Darby, and ending ½ a mile east of Alum Creek.

It shows the basin-shaped disposition of the impermeable blue clay east and west of the city; that the surface water which percolates downwards is accumulated and retained in the superimposed sands and gravel, and that the water supply of our wells is derived from the eastward, and would find its natural outlet along the bank of the river, which cuts across the inclination of the blue clay.

The surface water, falling west of the city, cannot add

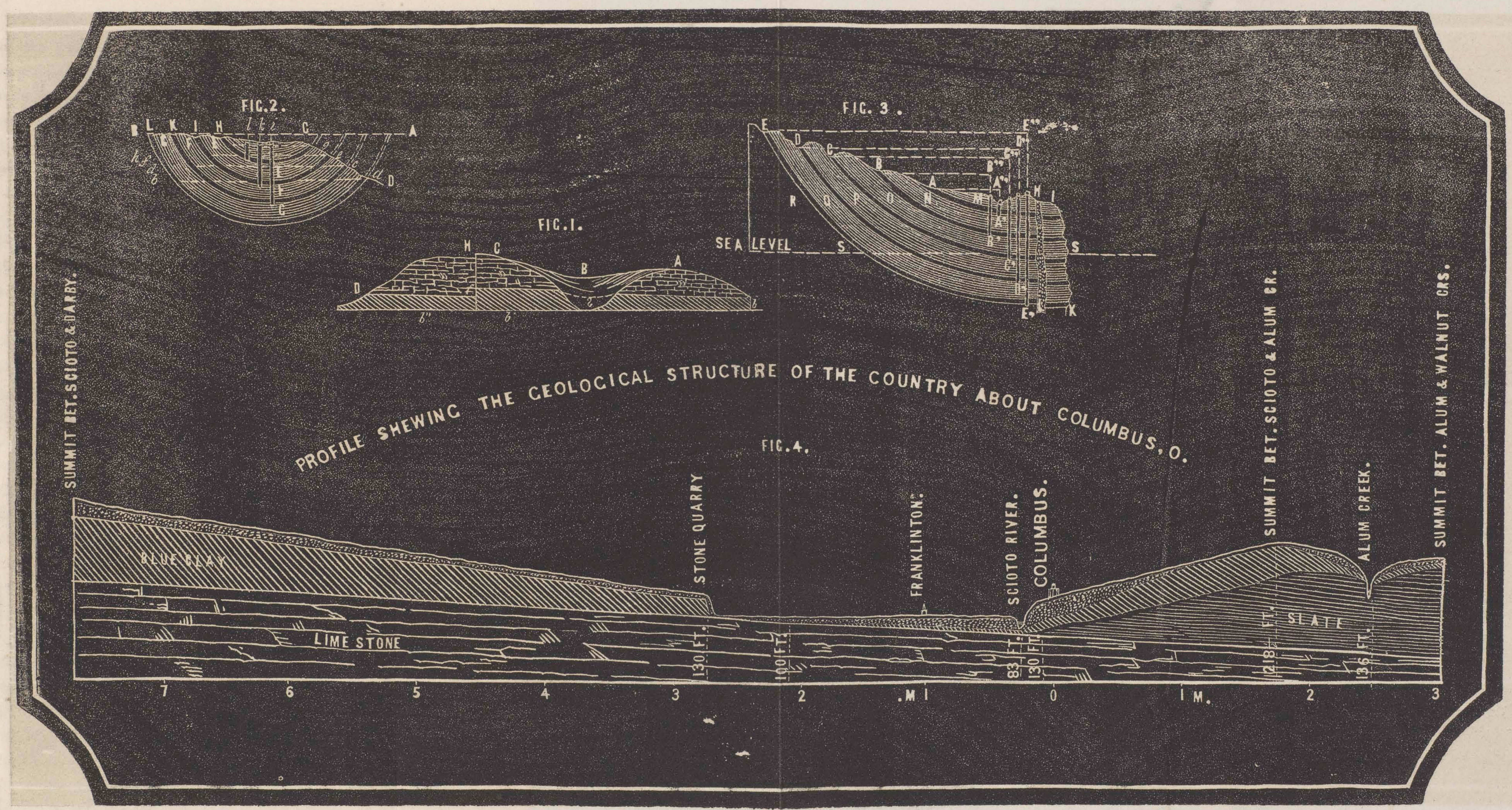
FIG. 2.
FIG. 1.
FIG. 3.
SEA LEVEL
PROFILE SHEWING THE GEOLOGICAL STRUCTURE OF THE COUNTRY ABOUT COLUMBUS, O.
FIG. 4.
SUMMIT BET. SCIOTO & DARBY.
BLUE CLAY
LIME STONE
STONE QUARRY
130 FT.
100 FT.
FRANKLINTON.
SCIOTO RIVER.
COLUMBUS.
83 FT.
130 FT.
SUMMIT BET. SCIOTO & ALUM CR.
218 FT.
SLATE
ALUM CREEK.
136 FT.
SUMMIT BET. ALUM & WALNUT CRS.
7
6
5
4
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3

to our water supply; for, sinking down through the superficial materials, until reaching the blue clay, it finds its way along the inclined surface, and is retained in the great deposit of sand and gravel which lies between the city and Sullivant's hill, three miles to the west.

It is to be borne in mind, that the dip of the strata in this region is eastward, and the water supply of an Artesian well must come from the westward. Were a well sunk to any great depth within the city limits, it would reach the limestone rock. Whether this limestone would prove water-bearing would depend upon circumstances. We would have to assume that the great deposit of blue clay is interstratified with beds of porous materials, which come to the surface, and would conduct the surface water *through* the blue clay into the limestone; *or*, that a portion of the rain water falling to the westward finds its way along the strata *beneath* the blue clay, which extends into Madison county, and overlies the limestone in many instances to a depth of more than a hundred feet.

Our streams flow south, cutting across the stratification, and forming valleys, which give vent to the water in the form of springs, as in diagrams Nos. 1 and 2.

It is true that the lower beds of the cliff limestone (that found here) crop out and rise to the surface as we go west to the neighborhood of Dayton, where they are *underlaid* by the beds of blue limestone, with their interstratified marls. And it is possible that a portion of the water falling on them, may find its way eastward, along the inclined strata, and be reached under the city of Columbus at the depth of 1200 to 1500 feet.

Having disposed of the aqueduct and Artesian well, we will now consider the other plan—that of a reservoir, supplied by pumping. This, in fact, is the plan adopted at Philadelphia, Wheeling, Zanesville, Cleveland, Chicago, Milwaukee, and other places. The conditions requisite in this case are, that there shall be, 1st, an available and abundant supply of pure water; 2d, that there shall be provided a reservoir of sufficient capacity, at least, to furnish a head to force the water through the distributing pipes. This pressure of a column of water is to be obtained by locating the reservoir upon ground naturally elevated, or raising it to the proper height by an artificial mound, or by building a tower to contain the distributing tank.

A third element is an unfailing power to work the pumps. Fortunately we can command this power, in the shape of steam, which is applied in other places to pump millions of gallons every 24 hours.

As to the source of water supply, I cannot speak with certainty; but it is highly probable that it can be obtained either from the Scioto River or Alum Creek. Supposing the water to be taken from the Scioto, it would have to be elevated by the pumps into a distributing tower, for nowhere adjacent to the city is there any ground suitable for the location of an earthen reservoir. The distributing tank should be some 65 feet above the curb stone at the American, which would furnish a sufficient pressure to force the water into the fourth story of the houses, and in many parts of the city would elevate it more than a hundred feet, or high enough to throw it over the housetops.

Two points suggest themselves as suitable places to

locate the tower: the one Goodale Park, the other at or near the intersection of State and High Streets.

In favor of Goodale Park, it may be said the city owns the land, and would not be under the necessity of purchasing a site for the tower; and, what would be far more important in the view of many, the water could be taken out of the river above the city, and free from its drainage. In accepting the gift of the Park, a moral obligation at least has been incurred, to adorn and embellish this ground, so as to carry out the design of the generous donor, and make it contribute to the health, comfort and pleasure of our citizens.

Against this location is the fact that ground would have to be purchased about the month of Whetstone, on which to place the pumps and engine house. And 2d, the great length of pump main between the engine and the tower, as well as an increased length of distributing main between the tower and the city.

It should be observed here that the expense of pump main might be greatly lessened by substituting a brick tunnel between the river and the Park, should it, on examination, be found to answer. By this means, the pumps, engines, and tower, might be placed on the same ground, and under one supervision.

In favor of the other location, is the fact that the city owns ground on the river bank at or near the foot of State street, on which the engine and pump house may be built; 2d, the much shorter pump and distributing mains necessary; 3d, the streets descend in every direction from this point; 4th, the tower might be used for a look-out in case of fires, and it would be a proper place for a fire bell.

Against this place it may be urged, first, the impurity of the water, contaminated as it is, in the opinion of our citizens, by the drainage and the sewerage of the city; second, the necessity of purchasing ground on which to place the tower. But little difference in expense would be found between the two places, and that most probably in favor of the State street location; and I am strongly inclined to believe that the river water in front of the city is *far less* contaminated by sewerage, than is generally supposed. In fact this objection is more imaginary than real, for water has a great faculty of self-purification; at any rate a few analyses will settle the question.

From the rapid ascent in the grade of the Central Railroad eastward from the depot, (said by Mr. Page, engineer, to be 52 feet to the mile for a distance of $1\frac{3}{4}$ of a mile, and as the road ascends upon the lowest ground, it is fair to presume that a greater height than we have stated can be found,) there is reason to suppose that a spot may be found in the vicinity of Alum Creek, a mile or two from the city, possessing advantages superior to either of the others; and, if the creek can furnish a sufficient quantity of water, fulfilling nearly all the requisites for a site for water works.

The superiority of this location would consist in the probable greater purity and softness of the water, *and a natural elevation some* 65 *feet higher than the intersection of State and High streets*, whereon, partly by excavation as well as by embankment, an earthen reservoir *of much greater capacity* than in either of the other places, can be cheaply constructed. In the items of pump and distributing mains, there would be an increase of expense; but this would be in part counterbalanced by the greater

cheapness of the land on which to erect the works. And it will be observed that with a tower, the reservoir, or tank, would necessarily be of limited capacity, and even if containing a million of gallons, according to the estimates in such cases, could furnish a supply for but 24 hours to a city of 30,000 inhabitants; whereas in this locality, an earthen reservoir of 40 or 50 times the capacity of the tower, could be constructed for the same money. And within such a reservoir, containing a larger body of water, certain chemical principles, and other agencies, would be constantly at work, *insuring* the purity of the water, even if it was comparatively foul when pumped in; and indeed I do not think the expense of construction would greatly differ in the three locations.

In a report of the Board of Directors of the Lake Hydraulic Company, I find statements so entirely applicable to our condition, and the uses and advantages of water works so clearly set forth, that I will, with some slight alterations, adopt its language:

A leading feature in every plan for supplying a city with water, is that which contemplates the *thorough cleansing* of the streets as a sanitary measure. This is effected by means of hose and jets, attached to the hydrants. All refuse matter which, in the traffic and travel of an active business population, collects upon the surface of the streets, is thus speedily and completely removed. This matter, if suffered to remain, is rapidly converted into masses of putrifying filth, poisoning the atmosphere and engendering disease.

The experience of all populous towns demonstrates the impracticability of protecting the inhabitants from

miasmatic influences, or periodic disease, when such causes of contamination are suffered to exist. Our streets have mostly a *gravel surface*, the worst of all for resisting a heavy traffic, and collecting and retaining, in the loose material, all manner of liquid and fetid matter. The only sure preventive is the regular and copious application of water from the hydrants. The health reports of different cities, in our own as well as foreign countries, prior and subsequent to the introduction of water, show not only that disease, mortality, and the incidental expenses, were diminished from 10 to 20 per cent. by the abundant supply and daily use of pure water, but that the total number and cost of all hospital cases, with the amount contributed by private individuals to charitable purposes, and the tax necessarily incurred in the support of charitable institutions, were materially reduced by the same cause.

The striking contrast in the general appearance, cleanly habits and ordinary health of persons in cities where the supply of pure water is abundant, and of those who are debarred from this blessing, is a subject of frequent and familiar remark. The fact is well known to the medical profession, that localities, especially in suburban districts, which are unprovided with water, are the hotbeds of disease and pestilence. From these emanate those fatal epidemics which sometimes so severely scourge a crowded city.

Inasmuch, then, as the primary cause is to be found in the unhealthy condition of the atmosphere, resulting in part from the want of pure water, and as the consequences are frequently so fatal to life and so oppressive to property, it is but reasonable to suppose that the inhabitants

of a city would gladly aid in an object so sure to remedy the evil in question. Tax, in any shape, is a burthen; but disease is more oppressive than tax, for the latter draws upon the physical constitution of man, as well as upon his pecuniary means. Every citizen, then, has a direct personal and pecuniary interest in the construction of water works, and a double incentive to aid the important enterprise.

Water works, again, constitute an active agent in developing productive labor, and affecting beneficially the pecuniary and animal economy of large towns.

Whatever physical causes induce disease and weaken the energies of labor, tax capital as much as they affect labor, since the yield is increased or diminished, in proportion as the body is more or less vigorous; and when the health of the working classes suffers from the want of pure water or fresh air, it is not only time and money lost to them, but in the diminution of productive labor, it is a loss to the community also.

Whatever, therefore, tends to improve or preserve the health of the laboring classes, is not only a direct benefit to them, but an advantage to the whole community. In this point of view, water works exercise an active influence in the development of productive labor, and improve health, prolong life, diminish taxes, and increase wealth.

Numerous instances might be cited where their influence in all these particulars, upon cities and towns which had previously suffered greatly from the deficiency of pure water, was as marked as it was salutary.

In domestic life, the hydrant and jet largely contribute to perfect the arrangements for home comfort, and

assist in the operations of housewives; and for the bath or the toilet, no cosmetic produced by art, could equal in virtue and efficiency that of pure water. No person undertaking the construction of a commodious dwelling, with a view to the slightest degree of comfort, would consider its internal arrangements at all complete without the convenience of a bath and water closet. These are esteemed the essential requisites of domestic comfort, and there is no habit so beneficial in its results, or which imparts such an agreeable and soothing sensation, and so animates and invigorates the body and mind, as the frequent use of the bath. It is a household appendage of inestimable value, which no family residence should be unprovided with. For all infirmaries and hospitals, the hydrant, bath and water closet, are absolutely indispensable for ablution and purification, to expedite the recovery of patients under medical treatment.

This hints again at tax, and the means of administering to the necessities of the afflicted, and restoring productive labor to its wonted action, by the introduction of pure water. And since water in abundance is so highly appreciated for its curative and manifold virtues, as applied to the various purposes of life, it is astonishing that its paramount importance is often overlooked by men of means and enterprise, who seem eager to engage in other public improvements, before home interests and comfort are first permanently secured.

Connected with the subject of water works, drainage and sewerage have occupied the time and attention of many enterprising and inquiring citizens, as well as legislative bodies, in most large cities. Immense sums of money have been expended on works of surface and

underground drainage, as a sanitary measure, and to effect pecuniary economy, by lessening the expense of manual or scavenger labor, by substituting for surface washing, that by hose and jets, as already described. Taking the quantity of water required at a cost to make it an object to a company to furnish a supply, the change has been attended with great economy in cities, as compared with manual labor required in cleaning streets. In many instances, at least *one-third* less the cost was found to result from water application, compared with the usual mode of procedure.

The subject of inquiry with reference to general comfort and economy, may probably be extended to the effects of traffic in dry seasons of the year on business or crowded thoroughfares of towns, where the amount of pulverized grit and dirt that the air is charged with, penetrating and damaging mercantile and household goods, is scarcely conceivable. Road dust forms a detritus, or mixture of mineral, animal and vegetable matter floating in the atmosphere, forming a filthy compound, which is inhaled and lodged upon the lungs, frequently causing injurious expectoration, and sometimes deep-seated disease. Then again, the befouling of linen and wearing apparel, from the annoying effects of dust and want of water, subjects the population of a town to double the expense for cleanliness and neatness of personal appearance, that otherwise would be incurred under a thorough system of water supply; besides the annual saving of soap and domestic labor would be enormous, and an important consideration of economy.

The fire department of every city has claimed more attention, perhaps, than any other branch of public ser-

vice, and is a subject which has been investigated with greater interest than any yet considered with reference to water works: as well to ascertain the extent to which water works have been valued as an acquisition to the fire department, as to show how far they may be relied upon as a means of extinguishing fires, and as a saving of life and perishable property with dispatch and economy. The common origin of fires may be traced to chimneys and stove-pipes, for want of sweeping, and sometimes to willful negligence and inattention on the part of domestics, even under the utmost vigilance and precaution of housekeepers to prevent its occurrence. It is exceedingly difficult, by any means, to guard effectually against the frequency and extent of fires, as intoxication, incendiarism and spontaneous combustion are to be included among the prolific causes. However, with an adequate supply of water at hand when ignition takes place, the speedy application of the jet, from a family or private hydrant, would immediately extinguish fire, or hold it in check until the alarm could be given, and the fire engines brought to the spot to suppress it at once. Under the plan in view for watering the city, all arrangements for connecting hose to fire plugs will be made, so as to provide facilities for applying water to fire without the aid of fire engines. A mutual protection can be entered into, among property holders on different blocks, by procuring for the tenantry a few sections of hose at a very small cost, to be brought into requisition at a moment's notice, to extinguish fires. Considering, then, the present exposed situation of our city, without water supply, its condition is one of imminent peril, as the sole reliance for the protection of life and property from the

ravages of fire necessarily rests upon the fire department alone. And the very great uncertainty of finding a sufficient supply of water, when and where required, in the emergency of fire, is a circumstance, not generally understood, that doubles the risk of underwriters, and necessarily augments insurance tax to an amount commensurate with that risk; thus creating a burthen upon the property holders, which would be essentially obviated by water works.

The means of extinguishing fires in New York, after the introduction of Croton water, reduced the insurance to 25 per cent. less than before, and the number of fires and consequent losses, was but *half* that which previously occurred. From this good result, not only the property holders, but the insurance companies also, were immensely benefited, notwithstanding insurance rates were greatly diminished in consequence of it; because the interests at stake, and the losses of both, are comparatively mutual.

It will be found that a great saving will be effected in the fire department, by substituting hose and jet. Numerous instances of applying the hose and jet in direct connection with the water pipes, have completely demonstrated the practicability and efficiency of that mode of extinguishing fires, as it is found, for speedy application and immediate effect, to be the most effectual and simple of fire annihilators yet employed. One man, at a moment's notice, can bring the water to bear with as much execution towards the extinguishing of fires, as would require a half hour or more warning, and 15 or 20 men, to do with a fire engine, the hose and jet having all the advantages of start, which might be the

means, perhaps, of saving many valuable lives, and a large amount of property, from destruction.

When a just comparison is drawn between one man's labor and the cost of this simple apparatus in the one case, and the compliment of men required to man a fire engine, and the cost of the complex apparatus, with the expense of keeping the same in repair, in the other case, very just opinions may be formed with regard to the great economy and reformation to be effected in the fire department, by the introduction of water. Yet the disorganization of the department is not contemplated by any means, but merely the addition of a potent auxiliary, to facilitate its operations, and supersede the use of unwieldy apparatus as far as possible.

Fires frequently occur in cities which require the engines to throw water for several hours. In case of fire in this city, we have to rely almost wholly upon the supply contained in the public cisterns. It has been demonstrated that our steam fire engine can empty one of these cisterns in fifteen minutes: so that a fire of two hours' duration, would require the contents of eight cisterns, a greater number than the hose of the fire department can command from one point. This fact strikingly illustrates our exposed situation, and that an abundant water supply ought to precede the introduction of steam fire engines.

There is another matter of importance to property owners, worthy of mention as connected with water works, which is, that the property fronting on all streets where the lines of water pipes are laid, is *immediately enhanced in value,* from the circumstance that the risk of fire is thereby diminished, and the means of promoting

domestic comfort provided by introducing a fountain of unfailing water at the threshold of every man's home.

The most reliable statistical information has been gathered with great pains and research, to obtain a ready answer to the mooted question, *whether the investment in water works*, as a pecuniary measure, will insure remunerative returns? To all such inquiries the answer is the same, as to the results of several well managed water works. Taking the average of their operations at date, the annual yield or revenue found, was equal to $20,000 on every 10 miles of water pipes laid: showing a steady annual increase of revenue, as the population becomes greater, to double, and frequently three times that specified as an average. For maintaining the works in successful operation, 20 per cent. of the revenue should be deducted, which leaves a net revenue of $15,000 per annum. It was also found that the permanent expense of conducting water works, varies but little in supplying any number of miles of water pipes, except what arises from the small additional daily consumption of fuel required to pump a water supply.

From the very worst showing of the case, and from moderate expectations, *at least* 12½ *per cent. would be paid* on the cost of water works having twenty miles of water pipes laid. Hence it follows, that every additional mile of pipe extended, increases the general yield in a greater ratio than before.

Nothing has been allowed here for the condensing of the population in thickly settled districts, which will perhaps add 5 per cent. revenue to all old lines of pipes for every 10 miles of new pipe laid: making 17½ per

cent. annual dividends on 20 miles of water pipes, as the most probable result of practical experience.

The successful operation of all water works in the United States, affords the best evidence in favor of the project under consideration, and decides any question of doubt to a reasonable mind, with regard to water works as a pecuniary investment. This assertion is strengthened by the well known fact, that when stocks or bonds are brought into market, none are more eagerly bought than those of water works companies. This would seem to justify the expenditure of any amount of money that may be required in the construction of such works. Whatever be the cost of construction, and expense of maintaining water works in successful operation, these form the basis upon which all assessments of rates for water supply to consumers are made; and it is the positive certainty of remunerative returns, which affords the sole ground of the universal confidence known every where to exist with reference to water works as a reliable source of revenue and profit.

Much more might be said in behalf of water works, as a means of ornament, as well as comfort, cleanliness and safety to cities. Jets, fountains and pools, for the embellishment of gardens, squares and public grounds, are deservedly esteemed in all large cities.

Thus have been enumerated some of the more obvious and signal advantages which the possession of an abundant supply of pure water confers upon a city. Its importance has been exhibited in the preservation of the public health, in the promotion of domestic comfort, in the protection of property from fire, in the enhancement of the value of real estate, in the cleansing and adorn-

ment of the public streets and squares, in the development of productive industry, in the general saving of tax, and in the increase of capital, population and prosperity.

In conclusion, I respectfully suggest to your honorable body, that an appropriation of from $100 to $150 would be well expended during the coming summer, in ascertaining by actual measurement the flow of water in the Scioto and Alum Creek, and in procuring a few analyses of the water from the different localities, under their varying circumstances.

My object in this communication is simply to call attention to the fact that in all probability, we have the facilities for procuring a supply of pure water.

I make no statement as to the cost, for I have neither the data nor the knowledge to enable me to form a reliable opinion. I can only hazard the conjecture, that works adequate to the present and all future wants of the city, could be constructed for from $250,000 to $300,000. But I leave it to the skill of the engineer, to furnish a matured plan and estimate of the work, and to the wisdom of the city fathers, to provide the ways and means, should it be deemed advisable at any time to prosecute the undertaking.

Respectfully submitted,

J. SULLIVANT.

May 26, 1856.